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Observations on the Mammals of Mackay Island National Wildlife Refuge, Virginia and North Carolina

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Mackay Island National Wildlife Refuge lies at the southern end of Back Bay in the City of Virginia Beach, Virginia and at the northern end of Currituck Sound in Currituck County, North Carolina. Knotts Island, on which the refuge is located, is separated from the mainland by marshes and bays and from Currituck Spit by Knotts Island Channel. The marshes in the Virginia portion have been described by Priest and Dewing (1991). Other aspects of the physical environment, flora, and fauna of the area have been described in Marshall and Norman (1991).

I conducted a tentative study of the mammalian fauna of Mackay Island National Wildlife Refuge during the winter and early spring of 1963 and 1964. Most of the information presented here was derived from observations of mammals and their signs, riding the causeway and other roads at night, and specimens caught in small live mammal traps and snap traps set a various times during the course of the study. These observations establish a first checklist of the mammals of this area and provide historical data against which later information can be compared. The taxonomy in the checklist follows Webster et al. (1985).

Annotated Checklist

Order Marsupialia
Family Didelphidae

Didelphis virginiana (Virginia opossum) - Common. Preferred habitats include woods and thickets, although this species can be found throughout the refuge.

Order Insectivora
Family Soricidae

Blarina carolinensis (Southern short-tailed shrew) - The most common insectivore on the refuge. Five specimens were collected as follows: 2 March 1963, male, 100 mm total length (TOTL), 19 mm tail length (TL); 15 March 1963, female, 93 mm TOTL, 17 mm TL, associated nest under board contained 4 neonates with umbilical cords; 20 March 1963, female, 99 mm TOTL, 20 mm TL; 22 March 1963, male, 100 mm TOTL, 17 mm TL; 29 March 1963, 94 mm TOTL, 19 mm TL, contained five well-developed embryos. This species was found in fallow fields, pine stands growing in sphagnum bogs, and in cattail and phragmites marshes. Several skulls of this species were found in barn owl pellets.

Family Talpidae

Scalopus aquaticus (Eastern mole) - Burrows of this species were observed in lawns, cultivated fields, meadows, and thin forest.

Order Rodentia
Family Sciuridae

Sciurus carolinensis (Gray squirrel) - Restricted to the wooded sections of the refuge.

Family Cricetidae

Peromyscus gossypinus (Cotton mouse) - One specimen found dead on the road (DOR) near a pine woods section at the northeastern end of the refuge.

Oryzomys palustris (Marsh rice rat) - Common. Several specimens were caught in live traps and released. The following specimens were collected: female, 232 mm TOTL, 116 mm TL; male, 253 mm TOTL, 123 mm TL; male, 234 mm TOTL, 119 mm TL; unsexed, 235 mm TOTL, 115 mm TL; unsexed, 232 mm TOTL, 120 mm TL.

Microtus pennsylvanicus (Meadow vole) - Common in brackish and freshwater marshes. Numerous specimens were found under boards at the watch tower and several freshly killed specimens were seen near barn owl's nests. One specimen found on the causeway (male, 180 mm TOTL, 48 mm TL) may have been captured and killed by a raccoon. On 18 March 1964 a nest of this species was found under a board near the watch tower containing four young approximately five days old. An adult female left the nest upon lifting the board. The young averaged 50 mm TOTL and 9 mm TL.

Ondatra zibethicus (Muskrat) - Generally abundant throughout the refuge. There was an apparent a decline

in the number of muskrats seen during 1962–1964.

Family Muridae

Mus musculus (House mouse) - Common in areas around buildings, marshes, and cultivated fields.

Rattus norvegicus (Norway rat) - Commonly found in the marshes.

Family Myocastoridae

Myocastor coypus (Nutria) - This species inclined during 1962-1964 and was abundant throughout the marshes on the refuge.

Order Lagomorpha
Family Leporidae

Sylvilagus floridanus (Eastern cottontail) - Common on the refuge in farmlands, brushlands, woods, and gardens, but entirely absent from the marshes.

Sylvilagus palustris (Marsh rabbit) - Abundant in all the marshy habitats on the refuge. Seldom found together with the eastern cottontail.

Order Carnivora
Family Canidae

Urocyon cinereoargenteus (Gray fox) - Fairly abundant throughout the refuge in all habitats. Tracks of this species were found around carcasses of ducks, geese, and swans that were killed in the winters of 1962 and 1963.

Family Felidae

Felis rufus (Bobcat) - Several sets of tracks believed to be of this species were seen on 4 May 1964 in a ditch along Mackay Island road.

Family Procyonidae

Procyon lotor (Raccoon) - Common throughout the refuge in all habitats. As many as 15 or more were seen at night on the causeway. In the winters of 1962 and 1963 a number of dead geese, ducks, and swans were found partially eaten; all had raccoon tracks leading to the carcasses. One raccoon had apparently killed and eaten a meadow vole.

Family Mustelidae

Lutra canadensis (River otter) - Isolated pairs occur throughout the refuge. Tracks, slides, and other signs were frequently observed. On 4 May 1964 I found the carcasses of two snakes, northern black racer (*Coluber constrictor*) and rainbow snake (*Farancia erytrogramma*), that had been killed and partially eaten by an otter or otters. In the case of the rainbow snake, a hole had been torn in the venter and only the viscera had been eaten.

Mustela frenata (Long-tailed weasel) - Two DOR specimens (male and female) were collected.

Mustela vison (Mink) - Generally common over most of the refuge. It was commonly observed around the watch tower in the winter and early spring of 1963. Following the spring of 1964 the watch tower burned and minks were not observed in this area afterwards.

Discussion

The two most abundant mammals on Mackay Island I encountered in the early 1960s were rice rats and meadow voles. They apparently served as an important prey base for local avian and mammalian predators, such as mink, raccoon, gray fox, barn owl, marsh hawk, and others. These two prey species comprised the majority of the remains in the 1000+ barn owl pellets I examined from three nests. These pellets also contained an occasional skull of the southern short-tailed shrew and a few birds, mostly red-winged blackbirds.

The apparent decline of the muskrat population in the early 1960s is puzzling. The nutria population increased in size during this time, leading to the supposition that there is a negative spatial relationship between these species. Other reasons, such as an internal parasitic or disease epidemic, cannot be ruled out, however.

The range of prey consumed by two of the predators on Mackay Island, gray fox and raccoon, indicate their roles as generalists in this ecosystem. Both scavenge for dead prey, such as the migratory waterfowl killed during winter freezes, and live prey, such as the meadow vole apparently killed by the raccoon. Otters are uncommon predators of snakes, at least as far as known. The observations reported above represent the first known accounts of otter predation on these two snakes in Virginia (J.C. Mitchell, pers. comm.).

The marsh rabbit is now listed as a species of special concern by the Commonwealth of Virginia (Handley, 1991). It was commonly found in marsh habitat in the early 1960s, however, its status on Mackay Island National Wildlife Refuge today is unknown. Two other species of conservation concern, bobcat (status undetermined) and river otter (special concern) (Handley, 1991), were apparently common in the early 1960s. It is noteworthy to point out that the Pungo mouse (*Peromyscus leucopus easti*), a subspecies considered by the Virginia Division of Natural Heritage to be globally rare due to its small range (Pague and Buhlmann, 1991), was not observed or collected during my study.

The list of mammals of Mackay Island National

Wildlife Refuge reported above is based on the first known observations of these animals in this area. The tentative list is presented here so that it may stimulate a more complete inventory in the future and serve as a baseline against which changes in species composition may be judged.

A number of species not encountered in my survey may yet be found on Mackay Island because their ranges encompass this area and because the habitats in which they are known to occur are also found there. These include southeastern shrew (*Sorex longirostris*), least shrew (*Cryptotis parva*), star-nosed mole (*Condylura cristata*), eastern harvest mouse (*Reithrodontomys humulis*), white-footed mouse (*Peromyscus leucopus*), golden mouse (*Ochrotomys nuttalli*), woodland vole (*Microtus pinetorum*), and meadow jumping mouse (*Zapus hudsonius*).

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[Editor's note: The Norfolk Museum of Natural History, initiated about 1952, ceased to exist in the early 1970s, and was taken over by the Chrysler Museum of Art. The natural history specimens collected by de Rageot were stored in a warehouse; the mammals were subsequently lost or destroyed.]

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Invertebrate Prey of *Bufo woodhousii fowleri* (Anura: Bufonidae) from a Virginia Barrier Island

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The Virginia barrier islands harbor a diverse flora and fauna considerably different from those on the mainland (Klotz, 1986; Conant et al., 1990). The island's flora and vertebrates have been the primary subjects of research and inventory (e.g., Clovis, 1968; Dueser and Brown, 1980; Hill, 1986; Scott, 1986; Cranford and Maly, 1990; McCaffrey and Dueser, 1990a), while the terrestrial invertebrate fauna has received little attention.

Toads of the genus *Bufo* are well known prey generalists, consuming a wide range of invertebrate taxa. Most of the summaries of prey taken by *Bufo woodhousii fowleri* (Fowler's toad) refer simply to broad